GRAVEL

By FRED H. TRIMMER, E.E. 2

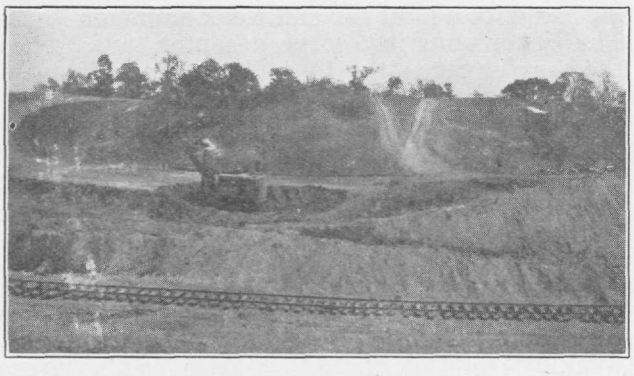
Accompanied by a young engineer of the State Highway Department, I drove the twenty miles from my home to the Circleville gravel plant of the Sturm and Dillard Company in a reasonably short time considering the means of locomotion, one of those rattling good model T's. We went into a neat little one story building, and introduced ourselves to Mr. J. H. Adams, the superintendent. When I told him that I was on the staff of the *Ohio State Engineer* and that I would like to go through the plant, as I intended to write an article on gravel mining and washing, he said that he would be very glad to show us through himself.

As we stepped outside the office he pointed out the stripping operations. The gravel, he told us, was covered with a topping of soil and clay which varied in thickness from several inches to ten or twelve feet. Where the topping of soil is not over three or four feet, it is removed with a steam shovel and carried away with trucks, and the gravel thus exposed is taken out with a steam shovel of large capacity. "There is where the profits go," our guide said with a smile as he pointed to the three trucks and the steam shovel engaged in removing the worthless topping so that the gravel could be gotten at.

"What does it cost to remove this topping?" I asked.

"About a hundred and fifty dollars a day," was his answer. "Do you see that pile of earth out there?" He pointed to a huge mound of earth a quarter of a mile to the north, "that pile cost us several thousand dollars."

We went down to where workmen were digging the gravel out of the bank with a large steam shovel and loading it into pneumatic dump cars. As we walked down the hill Mr. Adams told us about the geological formation of this particular bank. The gravel lies in streaks and kettle holes, large round depressions ranging in size from one hundred to five hundred feet in diameter. At the base of the hill we stopped to watch the shovel fill the cars which hold about twenty tons of gravel each, and are drawn by a small locomotive on standard gauge track. When the cars were loaded, we followed them up to the gravel washing plant. Only within the last few years, said our guide, has much gravel been washed. When we arrived at the plant I noticed that there was a grille of railroad rails about ten inches apart through which the gravel evidently passed when dumped. This, I was informed, was a "grizzly" onto which the dump cars were emptied sideways by tilting with a compressed air mechanism which is incorporated in the construction of the car.



Scalping Operations

When the noon whistle blew we learned that Mr. Adams did not go to lunch, but always inspected the machinery during the noon hour, and we asked if we might accompany him. We started up into the bank where past operations had been carried on and as we walked along the railroad track I snapped a few pictures with my camera. I glanced back toward the plant and was surprised at the number of men that were going to lunch. "About how many men do you employ?" I asked. "A hundred and seventy-five," he said. As we proceeded along the track he showed us places where the gravel had not been removed because the depth of the top soil made it unprofitable to do so. I happened to look to my left and saw a stream of water or a swamp, I did not know which.

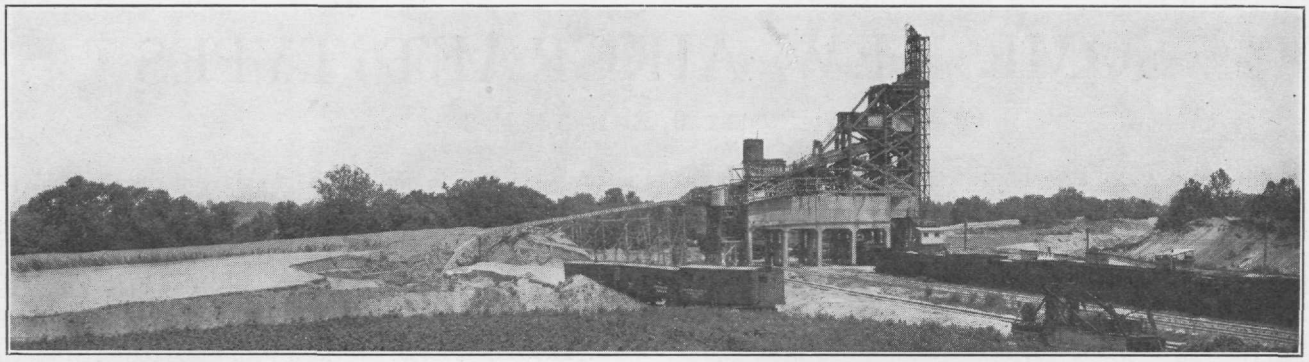
"That used to be the Scioto river but now it is a sewage canal," he explained. The stream surely looked and smelled the part, for the water was very low on account of the dry weather. Presently I noticed that we were walking on a bank of sand about forty feet high right near the river and I wondered what this sand was doing here. He told us that more gravel is sold than sand so the surplus from the washer was taken out here and dumped to make a levee to keep the river from flooding the gravel bank. We then went down to a lower track which was laid near the level of the river. On one side was the sand levee and on the other was the gravel face of from twenty to fifty feet in height. We could look in either direction and see where tons and tons of gravel had been removed.

We stopped to rest a while. "Are there any questions you would like to ask?" he said. (I had already asked a hundred or more I think.)

"Yes," I said. "How much gravel do you estimate has been taken out of this bank?"

"Between one and two million tons of sand and gravel have been taken out since March, 1928," he replied without hesitation, "that was when this plant was put in operation. Our company is a railroad construction company and this bank was opened to supply sand and gravel for the construction of a piece of track near here. Since that time the plant has been running at full capacity to supply the needs of our own company in its construction work and the orders of our customers."

As we were walking back toward the washer he pointed out the places where he expected to operate in 1931 and where he would place the waste topping them. He also told us of his plans for 1932. Here was a thorough man who had every detail planned and told us of them with an enthusiasm which was contagious. A coal tipple which he had built was the next thing he called



General View of Sturm and Dillard Co. Gravel Plant, Circleville, Ohio

to our attention. The coal is taken from the cars and put in this hopper by a steam shovel. The locomotive just runs under the hopper and the fireman pulls the chain; a very simple and efficient arrangement.

We next went to where the gravel is dumped from the cars into the pit from which it is taken to the top of the washer by two skips or buckets, each holding six tons. They run on guides and are hoisted by cables controlled by automatic machinery. When one bucket is going up the other is coming down. They are lifted by a one-inch steel cable, wrapped around a drum which is connected to the automatic hoisting device. This hoisting device is almost human in operation. In fact, it does better than a human could do.

The operation of the skips is something like this: one skip is at the top unloading while the other is at the bottom loading. They are left in this position for a certain definite period of time which is calculated to be sufficient lor loading and unloading. At the end of this period the skip is elevated at the rate of 156 feet per minute, but on approaching the top is automatically slowed down to 68 feet per minute. This part of the plant is 100 per cent automatic in operation and has never caused trouble since it was put in operation.

The safety features of the device are worth mentioning. If the cable should break, the skips would lock wherever they were and the motor stopped, or if anything should get jammed, the motor would be stopped automatically and the skips locked into position by means of a solenoid brake. The operation of the whole hoisting mechanism is controlled by a Cutler-Hammer control panel.

As the noon hour ended and the machinery started up, we climbed onto one of the rock crushers. This large machine which crushes boulders up to ten inches in diameter, weighs 68,000 pounds, and can crush 800 tons of rock in ten hours, is driven by a 100 horsepower motor. The crusher consists of a cone-shaped steel piece which is about six feet in diameter at the base. This cone is surrounded by a hollow steel housing whose inside diameter is about three inches larger than the outside diameter of the cone which wobbles about in this housing and crushes the rocks that are fed down between it and the outside housing.

From the crusher we climbed the ladder to the top of the washer. The gravel is hauled to this point by the skips and is dumped into a bin from which it goes into an inclined, revolving, cylindrical screen, called the scalping screen. A large spray of water plays on the gravel as it revolves in this large screen and as the screen turns, the gravel gradually works to the lower end. That which does not go through the screen falls to the bottom of the washer into the crusher bins to be broken up into smaller pieces. The first eight feet of this scalping screen has 2-inch perforations, the next eight feet has 1½-inch perforations and the four-foot end section has 4-inch square perforations. The materials which pass through the 2-inch and the 1½-inch openings of the scalping screen join the flow into a 48-inch by 10-foot cylindrical rotary scrubber into which water is sprayed. The inside of it is fitted with projections which lift the gravel as the screen revolves and allows it to fall through the water. In this part of the plant the gravel is scrubbed clean of any silt or organic matter.

Just at this point one of the workmen called our friend aside and we were left to look around for ourselves. From the top of this 100-foot washer we could see for some distance in any direction, for the surrounding country was very flat with the exception of a few low hummocks, probably of gravel. We could plainly see all the operations of the scalping and loading crews and it was not until this moment that I began to realize the true size of the operations.

Mr. Adams soon returned and continued with his explanation. From the scrubber, the material flows into a conical screen with ¾-inch perforations. That which goes out the end of the screen,

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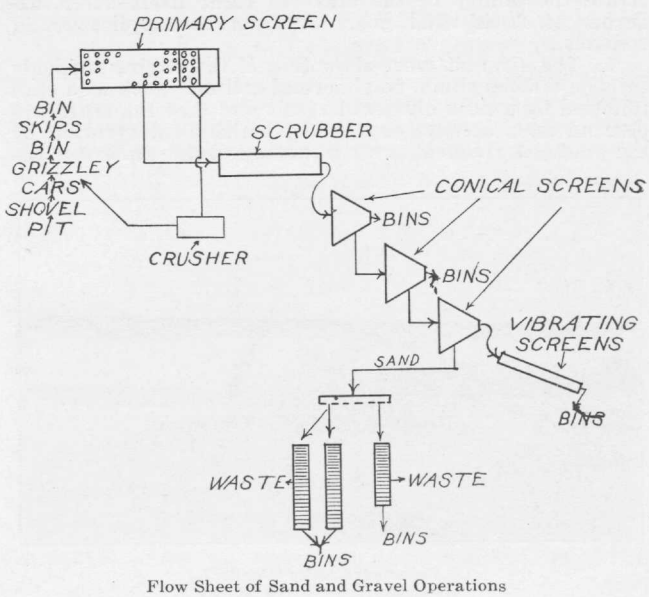

Flow Sheet of Sand and Gravel Operations

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that over ¾-inch in diameter, goes down into bins. The material that goes through the perforations goes on into another such screen with ⅜-inch perforations. Like the first screen, the material which goes out the end, that larger than ⅜-inch, goes into bins. That which goes through the perforations of the second screen goes into the third and last conical screen. The perforations of this screen are ⅛-inch by ⅝-inch slots. That which goes through these perforations flows through a screen with $\frac{3}{16}$-inch perforations. From there it goes into three long narrow boxes or basins about one foot deep and three feet wide which are filled with water. The silt flows out the top, being held in suspension in the water, and the sand settles to the bottom and is removed by drags which consist of metal pieces about 6 inches by 36 inches. These are on an endless chain and scrape the bottom of the basin as they revolve and thus pull the sand up the sloping side and into a bin. As these drags returned out of the water to the lower end of the basin I noticed that a small spray of water was turned on them.

"Why the water?" I asked.

"Just a little idea of my own," he replied. "You see that when the drags return there is a small amount of sand hanging to them? By washing this sand off we can save tons a day that would otherwise go out with the waste and silt."

He told us that the sand from this drag classifier contained only 0.8 per cent silt. I noticed that the overflow water and the waste materials were flowing into a piece of land about five acres in area which was enclosed by a wall of earth about twenty feet high. "That bank of earth cost us quite a lot of money," he said. "That's what makes the overhead high. Now let's go back and follow the material which comes out the end of the last conical screen."

This material falls to a 3-inch by 6-inch double-decked vibrating screen. The upper deck of this screen is equipped with ¼-inch perforations and the lower with ⅛-inch wire cloth. These screens act as a cleaner for the finer sizes of gravel, remove any objectionable oversize, and give the desired sizes a final wash to remove any remaining sand. A spray of water plays on these screens as they are vibrated by an eccentric at the rate of 1200 vibrations per minute. At Mr. Adams' suggestion we took hold of one side of the screen and the vibrations were so rapid and so violent that it made one's arm tired in a few seconds. He took a handkerchief from his pocket and laid it on the side of the screen and it slowly moved toward the top of the screen.

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"Now you have seen everything from the raw gravel to the refining and washing. We will now go down and see the loading of the cars and motor trucks," said our friend. We went down below and saw the loading operations which are very simple. The cars are pulled under the bins and the gravel let fall down through a gate controlled by a long bar which is operated by a workman standing on a small elevated platform which enables him to see when the car is full. As I stood there watching a freight car being loaded with sand, I again noticed the water main leading to the top of the washer.

"How much water do you use here?" I asked.

"About two million gallons of water in ten hours," he said. We get it from the river and it is pumped with motor driven centrifugal pumps."

"Do things ever freeze up in the winter," I asked. (I did not even know whether or not operations were carried on in the winter months.)

"We operate the whole year with the exception of several weeks in January when we shut down for repairs but we do not have much trouble except when we are forced to shut down for a few minutes for minor repairs. Then the water freezes in all the pipes. Sometimes when it is very cold, ice forms all over the machinery and the plant looks more like an iceberg than a gravel plant. We have to chop it off then," he said.

We went around to the side and he offered us a drink; a drink from a hundred and fifty foot well which had been drilled all the way through gravel, he told us. While we were quenching our thirst with the cold water, we heard more about the operation of the plant. It has a capacity of 3,000 tons per day of ten hours. Practically all of the material produced has gone into general construction. At present they are shipping sand and gravel into Virginia to line a tunnel with concrete. This is unusual, for gravel is seldom shipped over a hundred miles. In this case the distance is 450 miles. This washer has direct rail connections with three roads, the C. & O., the N. & W., and the Pennsylvania.

AUTHOR'S NOTE: I wish to acknowledge the courtesy of Mr. Adams in taking me through the plant, and it has been a genuine pleasure to know him.